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ABSTRACT

An annotated bibliography, compiled as part of a 1-year project to look at factors affecting the participation and performance of Minnesota Indian girls in mathematics, contains 64 entries, dating between 1967 and 1982. Because Indian Students in general leave the public schools underprepared for jobs, and because the plight of Indian women is even worse than that of Indian men, the bibliography is intended for use by those who wish to think critically about the present situation in their schools and wish to plan and implement programs to address special needs in mathematics education for Indians, particularly Indian women. Resources listed include 32 journal articles, 13 conference papers, and 1 masters's thesis; ERIC document numbers are provided for 12 entries. Subjects covered include minority group achievement/performance in mathematics; sex-role orientation and stereotyping; math anxiety/avoidance; academic achievement (including mathematics) of Native Americans; sex differences in mathematical abilities/learning; mathematics education research; and cultural/sexual identity of American Indian women. (MH)

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AMERICAN INDIAN WOMEN IN MATHEMATICS

RC014372

An Annotated Bibliography of Selected Resources

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AMERICAN INDIAN WOMEN AND MATHEMATICS: AN ANNOTATED BIBLIOGRAPHY OF SELECTED RESOURCES

Compiled as part of a project entitled "Educational Equity for Minnesota Indian Girls: Assessment and Planning for Special Mathematics Programs," a grant to the Indian Education Section of the Minneapolis Public Schools from the Women's Educational Equity Act Programs, 1981-82.

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FOREWORD

The difficulties experienced by American Indian children in school have been described frequently in the literature. National studies indicate that three quarters of all Indian children are at least one grade level behind for their age, over one-half of all Indian students drop out of school, and, on the average, Indian students fall further and further behind as they progress through school until finally they are three to four years behind in school achievement by graduation.

Although Indian students in general leave the public schools underprepared for jobs, the plight of Indian women is even worse than that of Indian men. It is often said that Indian women and other minority women are doubly disadvantaged. One reason that this continues to be true is that, for jobs in many fields, mathematics is the "critical filter" which keeps down the percentage of women. Fewer women than men take advanced mathematics at the high school and college levels. Research shows that many women actually make critical decisions in their lives based on their desire to avoid mathematical activities.

While differences in mathematics test performance between men and women and between non-Indians and Indians have long been observed, recent research suggests that those observed differences are not innate but rather are the product of the complex interaction of socialization, educational exposure, and attitudes.

This bibliography has been compiled as part of a small, one-year project which begins to look at these complex factors affecting the participation and performance of Minnesota Indian girls in mathematics. It is hoped that it will be useful to those who wish to think critically about the present situation in their schools and those who wish to plan and implement programs to address the special needs in this area. Indian people, especially Indian women, possess great strength and potential. This bibliography has been prepared with the hope that it might help those who are striving to see that great potential be more fully actualized.

INTRODUCTION

The Indian Education Section is a part of the Equal Education Support Department of the Minneapolis Public Schools. The Section manages a variety of programs and research activities designed to assist school building personnel to better meet the special needs of Indian children. Several staff members have played a role in publishing this bibliography. They include Rosemary Christensen, Chippewa, the Director of Indian Education; Jan Witthuhn, Administrative Analyst; Chuck Robertson, Jr., Chippewa/Sioux, Administrative Intern; Steve Premo, Chippewa, Media Specialist.

Armstrong, Jane M. ACHIEVEMENT AND PARTICIPATION OF WOMEN IN MATHEMATICS: AN OVERVIEW REPORT OF A TWO-YEAR STUDY. Education Commission of the States, March 1980, ED 184878.

This study reports the results of a national study of 1,452 thirteen-year-olds and 1,788 high school seniors. Data was collected on achievement in mathematics, participation in math, sex-role stereotyping, career and academic plans, student attitudes toward mathematics, parental influence and influence of significant others, correlation and multiple regression studies were done to identify factors most affecting participation and achievement. (JW)*

Armstrong, Jane, and Kahl, Stuart. AN OVERVIEW OF FACTORS AFFECTING WOMEN'S PARTICIPATION IN MATHEMATICS. Paper presented at the American Educational Research Association Meeting, April 1979.

The purpose of this study is to determine the relative importance of each of many factors that previous research suggests may be affecting women's participation in mathematics. Affective variables which were measured related to sex-role stereotyping, career and academic plans, attitudes towards mathematics, and influences of "significant others." Cognitive variables were achievement in computation, problem solving, algebra, and spatial visualization. Background information was collected on mathematics course experience, grades in mathematics, type of school program, and socioeconomic status.

The analysis of the data collected in this national study suggest that among twelfth graders, the variables that do seem to be affecting participation in mathematics included attitudes toward mathematics, career and academic aspirations, and the influences of parents and teachers. Other variables, which previous research suggested were important, were not found to significantly affect participation. These variables include stereotyping mathematics as a male domain and peer influence.

Babad, Elisha, and Bashi, Joseph. ON NARROWING THE PERFORMANCE GAP IN MATHEMATICAL THINKING BETWEEN ADVANTAGED AND DISADVANTAGED CHILDREN. Journal for Research in Mathematics Education, V. 9, N. 5, pp. 323-33, November 1978.

This study from Israel concerns children who have migrated there from other countries: those with low IQ scores and low test scores, and those with trouble keeping up in school. Children with these characteristics have been labeled "disadvantaged." The hypothesis is that, when presented with unbiased teaching and proper materials, the performance gap between "advantaged" (those at or above grade level) and "disadvantaged" students with similar learning potentials will be reduced drastically. The means for this is cryptarithmetic, using letters to replace numbers and attempting to fit the proper number to the letter. Heavy emphasis was placed on student support and well-directed small steps in problems. It was found that extra time and effort placed on limited material brought mastery by almost all students, "disadvantaged" included. (CDRJ)

*Initials in parentheses are those of the person who wrote the review.

Bander, Ricki S., and Betz, Nancy E. THE RELATIONSHIP OF SEX AND SEX ROLE TO TRAIT AND SITUATIONALLY SPECIFIC ANXIETY TYPES. Journal of Research in Personality, V. 15, N. 3, pp. 312-22, September 1981.

This study compared the relationship of sex and sex-role differences to four measures of anxiety: math anxiety, test anxiety, and two measures of trait anxiety. Results indicate females reported higher levels of anxiety on all four scales, and a discriminant functional analysis indicated the greatest difference in math anxiety. (RC)

Bass, Willard P. AN ANALYSIS OF THE ACADEMIC ACHIEVEMENT OF INDIAN HIGH SCHOOL STUDENTS IN FEDERAL AND PUBLIC SCHOOLS. Southwestern Cooperative Educational Lab, May 1971, ED 064000.

A longitudinal study was designed to determine whether there were significant differences in academic achievement between on-reservation, Federal off-reservation, public on-reservation, and public off-reservation schools. The purpose of the study was to gather a variety of data on psychological and sociological variables and to investigate the relationship of those variables to achievement. A sample of students drawn from 21 high schools in seven states was stratified on the basis of sex, grade and geographic area, with approximately equal sex ratios. Tests administered at various times over a four-year period (1966-70) were: the California Achievement Tests, the California Short-Form Test of Mental Maturity, the Mooney Problem Check List, a questionnaire to obtain personal and familial data, a semantic differential on attitudes, the School Interest Inventory, the California Psychological Inventory, the Value Orientation Scale, and the Vocational Aspiration Scale. No reliable differences were noted in terms of achievement between the four types of schools. For the 45 categories for which significant achievement differences were registered, rankings were so variable that no hierarchial pattern or evidence of particular superiority or inferiority emerged. Appendices include tables of mean scores of criterion and control variables with analysis of covariance and adjusted criterion means by school type and by geographic area. (FF)

Becker, Joanne Rossi. DIFFERENTIAL TREATMENT OF FEMALES AND MALES IN MATHEMATICS CLASSES. Journal for Research in Mathematics Education, V. 12, N. 1, pp. 40-53, January 1981.

Ten high school geometry teachers were observed to determine if there was differential treatment of male and female students. A trend of higher quantity and quality contacts with male students was noted. (MP)

Benbow, Camilla Persson, and Stanley, Julian C. SEX DIFFERENCES IN MATHEMATICAL ABILITY: FACT OR ARTIFACT? Science, V. 20, N. 4475, pp. 1262-64, December 1980.

Substantial sex differences in mathematical reasoning ability in favor of males was apparently found by this study. The data was collected in an investigation of intellectually gifted junior high school pupils who took the Scholastic Aptitude Test. (MP)

Bradley, Claudette. NATIVE AMERICANS IN MATHEMATICS: THE STATE OF THE ART. Paper presented at the National Council of Teachers of Mathematics Core Conference, Reston, Virginia, February 20-21, 1982.

This paper cites many difficulties Indian students face in math. Some possible solutions are suggested. Towards this end, various programs and methods are discussed such as Extending Counselor Influence into the Classroom, Education via Radio among Guatemalan Highland Maya, Project SEED and the Oregon Mathematics Learning Center. No final solution is proposed, but a need for more culture-based teaching methods and more Indian teachers are suggested along with a need for continuing research and evaluation of Indian students. (CDRF)

Brochin, Bridget. AN ACCULTURATION PROBLEM CHECK LIST STUDY OF THE BAND OF CHIPPEWA INDIANS OF THE TURTLE MOUNTAIN RESERVATION, BELECOURT, NORTH DAKOTA. Master's thesis submitted to Indian University of Pennsylvania, August 1969.

Purposes of this study were: (1) to show the number and types of problems that the Turtle Mountain Band of Chippewa Indians of Belecourt, North Dakota, believe they have; (2) to ascertain the problem areas that are of greatest significance to the Indians; and (3) to compare the number and types of problems that these Indians believe they have with the problems of a control group in the non-Indian Borough of Indiana, Pennsylvania. A total of 92 junior high students, 58 high school students, 35 college students, and 82 adult Indians participated in the study. The control group was composed of 103 junior high students, 97 high school students, 40 college students, and 45 adults. The instrument used was the "Problem Check List" (Rural Youth Form, Junior High School Form, College Form, and Adult Form). The problems were totaled by areas (health and physical education concerns, relationship with people, citizenship, education, vocational and economic concerns, morals and religion, personal temperament, courtship and marriage, social and recreational concerns, and home and family), sex, levels, and groups. A percentage was computed for every problem in every group and level for all females and males. An analysis of selected significant percentages was then made. It was concluded that the Turtle Mountain Reservation group and the control group problem incidences were not significantly different, but the females in both groups reported more problems than did the males. (LS)

Bureau of Indian Affairs. NAVAJO AREA MATHEMATICS GUIDELINES. National Science Foundation, ED 164157.

Heavy emphasis is placed on development of understanding of arithmetic in this mathematics curriculum prepared specifically for Navajo children and intended for use in reservation schools. Materials are presented so that only when a given concept is understood are skills associated with it and a written format introduced. Learning activities expose students early to ideas of patterning and repatterning. The guidelines are to be used as a mathematical core for elementary school, not as a total curriculum. The more than 140 objectives are categorized according to four strands--comparative (sets, cardinal and sequential

relationships, grouping, place value, types of numbers), joining (addition and multiplication operations), separating (subtraction and division operations), and geometry (line, shapes, figures, measurement). Objectives are cross referenced according to strand components, and the guidelines also contain a cross reference with other textbooks available in the Navajo area. The guidelines are organized according to objective: for each, there are comments, prerequisite objectives, and at least two activities, with materials listed and directions for carrying them out explained. Illustrations of mathematical processes are provided, along with ditto sheets for some activities. The guidelines also contain a sample of the pupil's record sheet and a glossary. (RS)

Chipman, Susan, and Thomas, Veronica. WOMEN'S PARTICIPATION IN MATHEMATICS: OUTLINING THE PROBLEM. Unpublished paper under preparation for NIE, August 1980.

A review of current data about women and mathematics at the high school level suggests that there continue to be substantial sex differences in math course participation but that the problem is not so severe as many people believe. Longitudinal follow-up reveals that an early decision to enter a math-related field appears to be a necessary, but not sufficient, step toward actual entry. Finally, an analysis of high school math performace suggests that the highest achieving students in mathematics continue to be disproportionately male.

Christensen, Rosemary A. INDIAN WOMEN: AN HISTORICAL AND PERSONAL PERSPECTIVE. Pupil Personnel Services Journal, V. 4, N. 2, pp. 22, 1975.

This paper discusses the perceptions of Indian women, in written histories, as presented by traders, missionaries, and anthropologists. The paper suggests that each of these perceptions is limited and inaccurate. A comparison is made between role delineation in Indian and non-Indian society and between the women's movement as it is defined by both societies. The paper concludes with a brief discussion of how Indian women are presented in existing literature and what the needs are for further study in this area. (JW)

Cohen, Rochelle F., and Cohen, Michael R. OPENING NEW DOORS: TAKING SEX-ROLE STEREOTYPING OUT OF SCIENCE AND MATHEMATICS. School Science and Mathematics, V. 80, N. 7, pp. 566-72, November 1980.

Discussed are the effects of discrimination and bias caused by conformity to sex roles. Strategies including classroom organization, systemwide response, and students' activities are suggested for combating sex-role stereotyping within science and math classes. (Author/DS)

CONFERENCE ON AMERICAN INDIAN SCIENCE AND HEALTH EDUCATION. Science, V. 196, N. 4285, pp. 46-8, April 1977.

Reviews proceedings of the Conference on Health and Science Education in American Indian Post-Secondary Institutions. Representatives from 21 Indian institutions stressed institutional needs of funding for basic science facilities, obtaining faculty for health, science and math programs, and programming based on the needs of the Indian community. (CS)

Costantino, Toni (Ed.). WOMEN OF COLOR FORUM: A COLLECTION OF READINGS. Wisconsin State Department of Public Instruction, November 1979, ED 191975.

This collection of essays and articles is meant to provide a general introduction to the different issues and concerns that face women from a variety of racial and cultural backgrounds. Part I of this anthology addresses general issues confronting minority women. Following sections focus on individual groups of women: Native Americans, Hispanics, Asian Americans, and Blacks. Also included are a bibliography of readings about white women, a section on improving education for minority women, and a bibliography of current resources for the study of women. (MK)

Creative Associates, Inc. STATE-OF-THE-ART REPORT ON MATHEMATICS ACHIEVEMENT OF STUDENTS OF BLACK, HISPANIC, AND NATIVE AMERICAN ORIGINS. FINAL REPORT AND ANNOTATED BIBILIOGRAPHY--SELECTED RESEARCH STUDIES.

This two-part report reviews three major areas of influence in the mathematics learning of minority children: (1) learning style, personality and self-concept influences; (2) linguistic effects; and (3) school influences. Low mathematics achievement and nonparticipation of Black, Hispanic, and Native American children have become concerns of administrators, teachers, curriculum directors, and parents. As our society becomes increasingly more technological, the ramifications of this educational situation become more drastic. This paper reviews results of general studies on achievement of minority students and draws on research in mathematics achievement of the general population to locate the impact of certain factors on the minority pupil situation. Each of the three major factors identified are reviewed in detail, with the many interconnected factors discussed, and separate and combination effects assessed where possible. The report concludes with a summary and recommendations for changes in educational practices and suggestions for further research. The appendix contains a list of additional references on other factors relevant to mathematics learning of minority students. Part two of this report is an annotated bibliography of selected research studies in minority education. (MP)

de Wolf, Virginia A. HIGH SCHOOL MATHEMATICS PREPARATION AND SEX DIFFERENCES IN QUANTITATIVE ABILITIES. Psychology of Women Quarterly, V. 5, N. 4, pp. 555-67, Summer 1981.

On six mathematical subtests studied, males scored higher plus took significantly more algebra, geometry, advanced mathematics, and physics coursework. Females earned higher overall mathematics grades. After statistically controlling for the amount of coursework taken, sex differences disappeared on two quantitative tests and on spatial ability. (Author)

Donady, Bonnie, and Tobias, Sheila. MATH ANXIETY. Teacher, V. 95, pp. 71-4.

This article looks at factors causing women to be less successful at math and offers certain teaching methods which help to alleviate math anxiety. Factors such as poorly written school books, home influences and women's general lack of self-confidence are discussed. Teaching methods include relating math problems to the real world and more encouraged spatial work with young girls. (CDRJ)

Fennema, Elizabeth. INFLUENCES OF SELECTED COGNITIVE, AFFECTIVE AND EDUCATIONAL VARIABLES ON SEX-RELATED DIFFERENCES IN MATHEMATICS LEARNING AND STUDYING. Paper presented at the annual meeting of the American Educational Research Association (San Francisco, Ca., 1976).

This paper offers a detailed review of the literature concerning sex differences in the learning of mathematics. It identifies cognitive, affective and educational variables which have been either shown or hypothesized to contribute to sex-related differences in mathematics learning. The author analyzes each study in detail. One important finding is that many studies crediting boys with more mathematical ability than girls were carried out on populations in which the boys had actually studied more math than the girls. The author believes that, if the amount of time spent learning mathematics is equated for males and females, educationally significant sex-related differences in math performance will disappear. Much evidence is presented to support this belief. She concludes with recommendations in three areas: (1) directions for research; (2) intervention or demonstration projects; and (3) general considerations to optimize the chances that the money spent will accomplish its goals, i.e., to improve females' participation in mathematics now and in the future. (Author/BP)

Fennema, Elizabeth (Ed.) and Others. MATHEMATICS EDUCATION RESEARCH: IMPLICATIONS FOR THE 80's. Association for Supervision and Curriculum Development, 1981.

This research-oriented document is designed to give teachers insights into many of the causes of instructional problems in mathematics and to enable teachers to plan instruction which will be more responsive to identified needs. Individual chapter authors synthesize mathematics research findings, which provide three functions: (1) to describe what has been; (2) to find out what exists; and (3) to find out what is possible. Chapters in many cases have "counterpoint" responses from well-known researchers in mathematics education. Topics covered include: (1) the value of mathematics education research; (2) curriculum; (3) national assessment; (4) children's thinking; (5) teacher's decision making; (6) process-product research; (7) the sex factor; (8) problem solving; (9) computers; and (10) calculators. (MP)

Fennema, Elizabeth. MATHEMATICS LEARNING AND THE SEXES: A REVIEW. Paper presented at the annual meeting of the American Educational Research Association (New Orleans, La., February 25-March 1, 1973).

The purpose of this paper was to explore the literature to see what differences, if any, exist between the sexes in mathematics achievement from preschool through high school levels. Thirty-three studies were reported. Findings showed that there were no significant differences between boys' and girls' mathematics achievement in preschool or early elementary years. In upper elementary and early high school years, significant differences were not always apparent; however, when significant differences did appear, they were more apt to be in the boys' favor when the higher-level cognitive tasks were being measured and in the girls' favor when lower-level cognitive tasks were measured. No

conclusions were reached concerning high school learners. Six questions were raised concerning the relationship between sex differences and mathematics achievement. (DT)

Fennema, Elizabeth. MATHEMATICS LEARNING AND THE SEXES: A REVIEW. Journal for Research in Mathematics Education, V. 5, N. 3, pp. 126-39, May 1974.

Reviewed are studies of differences in mathematical achievement between boys and girls. Studies are sorted into preschool, early elementary, upper elementary, and high school categories to synthesize the results. A summary is presented in the form of questions which arise from analysis of these studies' results. (JP)

Fennema, Elizabeth (Ed.). MATHEMATICS LEARNING: WHAT RESEARCH SAYS ABOUT SEX DIFFERENCES. NIE Mathematics Education Reports, 1975.

This volume presents four papers originally drafted for a symposium on sex differences and mathematics education held at the 1974 meeting of the American Educational Research Association. Subsequent to the AERA meeting, the papers were revised. The paper by Fox reviews results of several contests to identify junior high school students who were precocious in mathematical ability, and subsequent instructional experiments aimed at improving the mathematical achievement of able girls. Aiken's paper presents factor analytic data concerning sex differences in attitudes toward mathematics and discusses several hypotheses to explain these differences. Armstrong's paper discusses results of factor analytic studies of sex differences in mathematics achievement and intelligence. Fennema's paper focuses on the role of spatial ability in learning mathematics and the relationship of this ability to sex differences in mathematics achievement. (SD)

Fennema, Elizabeth. MATHEMATICS SPATIAL ABILITY AND THE SEXES. Paper presented at the annual meeting of the American Educational Research Association (Chicago, Ill., April 1974).

This report defines spatial ability operationally (consisting of three components) and reviews possible sex differences in this ability as reported in the literature. The relationship between mathematical ability and spatial ability is discussed. Researchable hypotheses about how differential spatial ability may affect mathematics achievement are suggested. (Author/LS)

Fennema, Elizabeth. SEX DIFFERENCES IN MATHEMATICS-LEARNING: WHY? Elementary School Journal, V. 75, N. 3, pp. 183-90, December 1974.

Presents a brief review of the experimental literature pertaining to the apparent sex differences in mathematics learning after fourth grade. Factors discussed are inherent factors, spatial ability, verbal ability, attitudes, self-concept, and perceived sex role in mathematics. (Author/SDH)

Fennema, Elizabeth. SEX-RELATED DIFFERENCES IN MATHEMATICS ACHIEVEMENT: MYTHS, REALITIES AND RELATED FACTORS. NIE Report, February 1979, ED 160445.

Many more males than females are involved in post-high school mathematics study and in adult occupations that involve mathematics. This paper addresses the issue of whether this unequal representation of females and males is due to females' less adequate learning of mathematics or to deliberate choice of females not to study mathematics. After examining available studies relating to the matter, the paper concludes that, when both females and males study the same amount of mathematics, differences in learning mathematics are minimal. Significantly fewer females elect to study mathematics and therein lies the problem. Factors contributing to this are females' lesser confidence in learning mathematics and belief that mathematics is not useful to them, males' belief that mathematics is a male domain, and teacher treatment of males and females. (MP)

Fennema, Elizabeth. TEACHERS AND SEX BIAS IN MATHEMATICS. Mathematics Teacher, V. 73, N. 3, pp. 169-73, March 1980.

Examples of sex bias in mathematics classrooms are given, and ways of alleviating this bias and thereby improving mathematics instruction are described. (MK)

Fennema, Elizabeth. WOMEN AND MATHEMATICS: STATE OF THE ART REVIEW. Paper presented at the Nation Council of Teachers of Mathematics Core Conference, Reston, Virginia, February 20-21, 1982.

This paper explores many different possible reasons for poorer math performance by females. Among the resons discussed are sex-related differences in course selection, male superiority in high level cognitive tasks, low confidence - anxiety levels of females towards math, differing classroom treatment of male and female students, higher spatial ability among males, and the unwillingness of schools to make real attempts at remediating poor female performance. Two programs are described to indicate the feasibility of changing female math behavior over short periods of time. (CDRJ)

Fennema, Elizabeth. WOMEN AND GIRLS IN MATHEMATICS--EQUITY IN MATHEMATICS EDUCATION. Educational Studies in Mathematics, V. 10, N. 4, pp. 389-401, November 1979.

Sex-related differences in mathematics achievement and factors related to those differences are discussed in terms of research that has been conducted. (MK)

Fennema, Elizabeth and Others. COGNITIVE AND AFFECTIVE INFLUENCES ON THE DEVELOPMENTS OF SEX-RELATED DIFFERENCES IN MATHEMATICS. Paper presented at the annual meeting of the American Educational Research Association (Boston, Ma., April 7-11, 1980).

Results from the first year of a three-year longitudinal study (grades 6-8) of sex-related differences are reported. The purposes of the study are: (1) to understand more adequately the impact of one important cognitive influence (spatial visualization) on the learning of mathematics, and (2) to identify educational influences on the development of feelings of confidence in the learning of mathematics. Influences on confidence are being studied by observing classroom interactions and by a projective-type interview. Subjects in this portion of the study are above the mean in achievement and either high or low in confidence in learning mathematics. The impact of spatial visualization skills on the learning of mathematics is being studied in a one-to-one interview with subjects who are discrepant in spatial/verbal skills. They are asked to solve pictorial or analytic word and fraction problems. Transcribed interviews are coded for verbal information, picture information, picture use, mental movement, and scores. (Author/MK)

Fennema, Elizabeth and Others. INCREASING WOMEN'S PARTICIPATION IN MATHEMATICS: AN INTERVENTION STUDY. Journal for Research in Mathematics Education, V. 12, N. 1, pp. 3-14, January 1981.

The evaluation of the intervention program indicated that females in the experimental group increased their knowledge of sex-related differences and actually enrolled in more mathematics courses. (MP)

Fennema, Elizabeth, and Sherman, Julia. FENNEMA-SHERMAN MATHEMATICS ATTITUDES SCALES: INSTRUMENTS DESIGNED TO MEASURE ATTITUDES TOWARD THE LEARNING OF MATHEMATICS BY FEMALES AND MALES. Journal for Research in Mathematics Education, V. 7, N. 5, pp. 324-26, November 1976.

Nine different attitude scales are briefly described. They cover attitude toward success in mathematics, mathematics as a male domain, mother's and father's attitude, teachers' attitudes, confidence in learning mathematics, mathematics anxiety, effectance motivation in mathematics, and mathematics usefulness. (DT)

Fennema, Elizabeth, and Sherman, Julia. SEX-RELATED DIFFERENCES IN MATHEMATICS ACHIEVEMENT, SPATIAL VISUALIZATION AND AFFECTIVE FACTORS. American Educational Research Journal, V. 14, N. 1, pp. 51-71, Winter 1977.

The data do not support either the expectations that males are invariably superior in mathematics achievement and spatial visualization or the idea that differences between the sexes increase with age and/or mathematics difficulty. The pattern of differences in mathematics achievement, spatial visualization and affective variables strongly suggests the influence of socio-cultural factors. (Author/MV)

Fennema, Elizabeth, and Sherman, Julia. SEX-RELATED DIFFERENCES IN MATHEMATICS LEARNING: MYTHS, REALITIES AND RELATED FACTORS. Paper presented at the annual meeting of the American Association for the Advancement of Science (Boston, Ma., February 22-23, 1976).

Research concerned with differences in mathematical achievement of males and females is discussed in this document. Variables hypothesized to be related to achievement of women in general and to mathematics

fostered by school counselors, of hopeless inadequacy in math skills. Because most of the students interviewed had attended public schools, the implication is that public school math and science preparation is lacking for all, but especially for minority students. Changing math instruction can help remedy the situation. Some successful attempts at math instruction for Indian students employ a supportive atmosphere for math learning: individualized, noncompetitive programs, tutorials, math anxiety clinics, exposure to Indian role models, courses with an applied focus directly related to a career or community need, and initial math skills education based on everyday mathematics. (SB)

Green, Rayna. MATH CALLED KEY TO INDIAN SELF-DETERMINATION. Science, V. 201, N. 4354, p. 433, August 1978.

Describes a report of a conference on mathematics for Native Americans. Explores the barriers obstructing entry of American Indians into math-related areas and careers in the natural sciences. Recommends changes in attitudes, curricular and teaching methods. Accords special attention to Indian culture and systems of learning. (GA)

Green, Rayna, and Brown, Janet Welsh. RECOMMENDATIONS FOR THE IMPROVEMENT OF SCIENCE AND MATHEMATICS EDUCATION FOR AMERICAN INDIANS. American Association for the Advancement of Science, December 1976, ED 149896.

Focusing on three education levels (precollegiate, collegiate, and the graduate and professional levels), the recommendations are based both on "what appears to work" and on "what appears to be worth trying." A fourth group of recommendations is aimed at responsible governmental agencies and professional and other organizations. The recommendations include: that an assessment of science and mathematics education in schools serving Indian students be conducted; essential characteristics of successful approaches to Indian education in these areas be integrated; bilingual techniques must be used where language retention is maximal, especially on the elementary levels; an ethnoscientific approach to teaching high school science be used; concentrated attention should be given to math deficiencies; special programs must be established in fields where they do not now exist, i.e., physical sciences, mathematics, and resources development; greater efforts should be directed at identifying and recruiting Indian students for participation in special programs for minorities in scientific and technical fields; the developing Graduate Centers for Minority Education in Science and Engineering must make sure that they include within their plans, programs and staffing for the special needs of Indian students; adequate financial aid must be available to graduate students; some graduate and professional programs should conscientiously include a multi-cultural focus, specifically an Indian focus, in their training. (NQ)

Hollingshead, Maybelle Clayton, and Clayton, Charles. STUDY OF THE RELATIONSHIP BETWEEN THE PERFORMANCE OF INDIAN YOUTH ON THE CHICAGO NON-VERBAL AND THE WIDE RANGE ACHIEVEMENT TEST. Bureau of Indian Affairs, July 1971, ED 057933.

The investigation examined the "Wide Range Achievement Test" (WRAT) and its subtests (spelling, reading, and arithmetic), as well as possible differences attributable to the factors of sex, with the "Chicago

learning and studying in particular are considered: verbal ability; spatial visualization ability; confidence in learning mathematics; mathematics as a male domain; attitude toward success in mathematics; perceived attitudes of mother, father, and teachers toward one as a learner of mathematics; usefulness of mathematics; and effectance motivation in mathematics. Four conclusions are drawn: (1) sex-related differences in mathematics achievement are not universal, (2) many fewer females than males study mathematics in eleventh and twelfth grades, (3) the relationship between cognitive factors and differential learning of mathematics by the sexes is unclear, and (4) differential mathematics studying and mathematics achievement by the sexes is at least partially caused by socio-cultural factors mediated through sex-role expectations. (DT)

Fennema, Elizabeth, and Sherman, Julia. SEXUAL STEREOTYPING AND MATHEMATICS LEARNING. Arithmetic Teacher, V. 24, N. 5, pp. 369-72, May 1977.

Studies of differences between male and female performance in mathematics are reviewed. The authors conclude that the stereotyping of mathematics as a male domain has a subtle but powerful effect on women, especially as it affects decisions to continue or terminate the study of mathematics. (SD)

Fox, Lynn H. THE PROBLEM OF WOMEN AND MATHEMATICS. Report to the Ford Foundation, March 1980.

This paper summarizes the research literature in regard to three key questions concerning sex differences in mathematics:

1. What is the nature and extent of sex differences in learning and aptitude for mathematics?
2. What factors influence the learning of mathematics?
3. What factors influence the choice and pursuit of careers?

The paper differentiates between the learning of mathematics (achievement), the study of mathematics (enrollment), and aptitude (innate predisposition) and reviews research results in each area. Research literature on factors such as counselors, teachers, parents, peers, self-confidence, school variables, and perceptions of the usefulness of mathematics and mathematics as a male domain are also reviewed. (JW)

Green, Rayna. MATH AVOIDANCE: A BARRIER TO AMERICAN INDIAN SCIENCE EDUCATION AND SCIENCE CAREERS. Bureau of Indian Affairs, September 1979, ED 170084.

For American Indian students, math anxiety and math avoidance are the most serious obstacles to general education and to the choice of scientific careers. Indian students interviewed generally exhibited fear and loathing of mathematics and a major lack of basic skills which were caused by a missing or negative impression of the mathematics capabilities of Native Americans, a generally negative image of mathematics and scientists, dislike and fear of math forms without visible application to daily life and which require abstraction as a major tool, a perception of math courses and requirements as rigid, and a self-perception, often

Non-Verbal" (CNV) as a criterion variable. The 1970 study encompassed 72 Indian students (with a mean chronological age of 13.2 for boys and 13.4 for girls) attending the Riverside Summer Institute at Anadarko, Oklahoma. Test data obtained were examined through mean, standard deviation, standard error, and the Pearson Product Moment. The low correlation between the WRAT and the CNV indicates significant differences: WRAT results show greater retardation than CNV results; WRAT results show a greater variation below the standard mean than is indicated by CNV results; both tests indicate that females are above the mean, and the variation in differences from the mean of the two tests is about the same; WRAT scores show the greatest retardation on the arithmetic subtest for both males and females; males show greater deviation below the mean on the reading subtest; and girls show the greatest retardation below the mean on the arithmetic subtest. Cultural factors and tribal differences are cited as limitations to this study. Included with a description of the study and findings are a literature review, a 12-item bibliography, and tables showing mean, standard deviation, and standard error of test scores. (MJB)

Hollingshead, Maybelle Clayton, and Clayton, Charles. STUDY OF THE RELATIONSHIP BETWEEN THE PERFORMANCE OF INDIAN YOUTH ON THE WECHSLER INTELLIGENCE SCALE FOR CHILDREN AND THE CHICAGO NON-VERBAL. Bureau of Indian Affairs, July 1971, ED 057932.

Designed to investigate the performance of American Indian youth on the "Wechsler Intelligence Scale for Children" (WISC) compared to the "Chicago Non-Verbal" (CNV) for the purpose of establishing validity and reliability of the measurement and appraisal tools, this study analyzed test data from 71 Indian youth (aged 11 to 15) attending the Riverside Summer Institute, Anadarko, Oklahoma, in 1970. It was concluded that differences do exist among Indian youth on the two tests. WISC scores showed lower scale scores than the CNV except in performance. Males had a higher performance correlation on the WISC subtests than females. The performance scale of the WISC was higher for boys and girls than the CNV. The performance scale for males was 103.413 on the WISC and 95.289 on the CNV. Results indicated that the WISC is a better indicator of performance for Indian males than the CNV; however, cultural factors and tribal differences were considered as limitations. Included in addition to a description of the study and findings are a literature review; a nine-item bibliography; and tables showing mean, standard deviation, and standard error of test scores. (MJB)

Johnson, Martin L. BLACKS IN MATHEMATICS: THE STATE OF THE ART. Paper presented at the National Council of Teachers of Mathematics Core Conference, Reston, Virginia, February 20-21, 1982.

Black students are performing significantly lower than white students in math. Some suggested reasons for this are: 1) schools are not sensitive to black culture, 2) there is a lack of black role models, 3) there is a lack of people with interest in math achievement, 4) there is a lack of positive career conseling, 5) math is seen to be a white male subject, 6) math is seen as unimportant, and 7) students have no previous exerience with math success. Although studies are now being done

on this problem, more research is needed using minority researchers and instruments sensitive to black students and standardized on black samples. The validity of instruments currently used with black students is in question. Better teacher training is also mentioned as a possible solution. References to American Indians in this paper suggest that they score significantly lower on almost all math measures than do blacks. (CDRJ)

Kaplan, Barbara, and Plake, Barbara. THE EFFECTS OF SEX-ROLE ORIENTATION AND COGNITIVE SKILL ON MATHEMATICS ACHIEVEMENT. Educational Studies, V. 7, N. 2, pp. 123-31, 1981.

This is a study of 86 undergraduate college students, 29 males and 57 females. Three hypotheses were explored:

1. High cognitive development in formal operational thought and high mathematics performance are likely to occur together. This was confirmed.
2. Psychological sex-role orientation is associated with mathematics performance in that people with High Masculine (M) - Low Feminine (F) and High M-High F (Androgenous) traits will show higher scores in math performance than those with Low M-High F and Low M-Low F traits. This was partially supported by the study.
3. Male sex-role identification is more important for subjects with low cognitive development in regards to high math performance. This was not confirmed. (CDRJ)

Kidwell, Clara Sue. AMERICAN INDIAN WOMEN: PROBLEMS OF COMMUNICATING A CULTURAL/SEXUAL IDENTITY. Study prepared at the University of California, Berkeley, 1976, ED 172289.

In traditional American Indian cultures, sex roles were clearly defined and women were the keepers of the home, child bearers, and food gatherers. Sometimes, however, stereotypes and preconceptions become barriers to cross-cultural communication. For instance, feminists who see themselves as victims of male-dominated society cannot assume that Indian societies are male-dominated in the same way as their own nor that the system of rewards for being a wife and mother is the same in Indian society as in the dominant society. In one survey, 61 Indian women college students indicated a wide latitude in their knowledge of or definition of women's roles in their tribal cultures. The factors involved in a sense of cultural/sexual identity for Indian women may include language differences, participation in tribal ceremonies, residence on a reservation, or attendance at weekend pow-wows. Within their own communities these strategies are generally associated with the respect for the role of wife and mother that persists in Indian communities. For college and professional Indian women, communication strategies may be those of trying to inform people about Indian values or traditions and of helping break stereotypes. (TJ)

Kolata, Gina Bari. MATH AND SEX: ARE GIRLS BORN WITH LESS ABILITY? Science, V. 210, N. 4475, pp. 1234-5, December 1980.

The idea that females may be born with less mathematical ability than males is explored. Data from Benhow and Stanley, as well as from the Education Commission of the States, are considered. (MP)

Leder, Gilah. BRIGHT GIRLS, MATHEMATICS AND FEAR OF SUCCESS. Educational Studies in Mathematics, V. 11, N. 4, pp. 411-22, November 1980.

Two consistent areas of sex differences in mathematics are pointed out, along with the variety of reasons used to explain their causes. Two studies that examined students of both sexes who had revealed high mathematical abilities are discussed, with fear of success of girls highlighted as an important factor. (MP)

MATHEMATICS PERFORMANCE IN MINNESOTA: AN ANALYSIS OF STUDENT MATHEMATICS CHARACTERISTICS AND RELATED INSTRUCTIONAL IMPLICATIONS FOR MATHEMATICS. Minnesota State Department of Education, June 1976, MINE 002 416.

Analysis of state assessment of mathematics among students age 9, 13 and 17 found that 17-year-old boys performed higher than average while girls outperformed boys at 9 and 13. The study found that students attending schools in the suburbs or small towns performed better than average while students attending schools in large cities performed lower than average. On variables describing home background, the study found that the more positive the parental educational involvement, the higher the student's performance. Students' positive attitudes towards school and math were related to high performance as were use of educational materials such as calculators and computers, number of years enrolled in math courses, and high educational and career aspirations. Pupil-teacher ratio was not found to be significantly related to student performance. (JW)

McLaughlin, T. F. and Others. A COHORT ANALYSIS OF ACHIEVEMENT IN MATH IN NORTHERN CHEYENNE BEHAVIOR ANALYSIS MODEL OF FOLLOW THROUGH. Reading Improvement, V. 16, N. 3, pp. 192-4, Fall 1979.

When the Behavior Analysis Model of Project Follow Through was used with children from the Northern Cheyenne Tribe, 65 percent of the cohorts scored at or above grade level in mathematics. (FL)

Ortiz-Franco, Luis. SUGGESTIONS FOR INCREASING THE PARTICIPATION OF MINORITIES IN SCIENTIFIC RESEARCH. Paper presented at the National Council of Teachers of Mathematics Core Conference, Reston, Virginia, February 20-21, 1982.

This paper discusses how external and internal variables affect a minority student's performance in math and science. Included in these variables are looks at counselors and teachers, the school curriculum, parents, peers and the child himself/herself. Research discussed

indicates external variables are easier to impact and are more effectivly changed when interventions are sustained over long periods of time. Minority students seem to perform better when a heavy emphasis is placed on the basic skills of math and science. The article suggests that there is a further need for continuing programs of research and evaluation in this area. (CDRJ)

Owston, Ronald D. SYSTEMATIC COMPUTATIONAL ERRORS AND ACHIEVEMENT IN ELEMENTARY MATHEMATICS. Alberta Journal of Educational Reserach, V. 27, N. 2, pp. 114-20, June 1981.

Investigation of the relationship between systematic computational errors and achievement among native Indian children indicated a significant relationship between error type and achievement in multiplication but not in addition or subtraction. In multiplication, high achievers tended to make nonsystematic errors: low achievers tended to make systematic errors. (Author/CM)

Pedro, Joan Daniels and Others. ELECTION OF HIGH SCHOOL MATHEMATICS BY FEMALES AND MALES: ATTRIBUTIONS AND ATTITUDES. American Educational Research Journal, V. 18, N. 2, pp. 207-18, Summer 1981.

Attitudinal and attributional variables relating to the election of mathematics courses by females and males are identified. A small set of variables explaining the variance in female and male mathematical plans was found. These results may help in understanding why larger proportions of males than females elect mathematics. (Author/GK)

Plake, Barbara S. and Others. AN INVESTIGATION OF THE IOWA TESTS OF BASIC SKILLS FOR SEX BIAS: A DEVELOPMENTAL LOOK. Psychology in the Schools, V. 17, N. 1, pp. 47-52, January 1980.

This is a study which attempts to determine whether the Iowa Tests of Basic Skills are biased by sex. The test consists of four parts: Reading, Vocabulary, Math Concepts and Math Problem Solving. The tests were reviewed for any stereotypically male or female items. Though found, these items in general balanced out. Test results from third, sixth and eighth graders statewide were analyzed for those questions. Though subtests varied in one direction or another, taken as a whole, little evidence of sex bias was found. (CDRJ)

Plake, Barbara S. and Others. SEX DIFFERENCES IN MATHEMATICS COMPONENTS OF THE IOWA TESTS OF BASIC SKILLS. Psychology of Women Quarterly, in press.

This study attempts to determine if two mathematics subtests of the Iowa Test of Basic Skills are sex biased. Math Concepts and Math Problem Solving were studied. The tests were judged for stereotypically male or female items. Though found, these items generally balanced each other out. Test results from third, sixth and eighth graders statewide were analyzed on those items. No clear evidence of sex bias of this test was found. Surprisingly, girls in general performed better than boys on these math tests. (CDRJ)

Plake, Barbara S. and Others. SEX-ROLE ORIENTATION, LEVEL OF COGNITIVE DEVELOPMENT AND MATHEMATICS PERFORMANCE. Paper presented at the annual meeting of the American Psychological Association (Montreal, 1980).

This study of 69 young college students (18 male, 51 female) revealed effects of cognitive development and sex-role orientation on math performance. It was found that those with higher developed formal operational thought patterns performed significantly better on the math test. It was also found that those having high masculine, low feminine (all males in this study) and low masculine, high feminine (all females in this study) traits performed better than those with low masculine, low feminine (worst) and high masculine, high feminine traits (third best). (CDRJ)

Scott, Willard A. NEW MEXICO STATE INDIAN DROPOUT STUDY: FIRST YEAR REPORT: 1966-67. New Mexico State Department of Education, 1967, ED 060968.

Purposes of this study were: (1) to identify certain characteristics, influences, and causal factors relating to the school dropout; (2) to determine the extent and nature of the dropout program among American Indian students in the State of New Mexico; and (3) to bring the dropout program to the attention of educators throughout New Mexico. A dropout was defined as any student (grades 7-12) who leaves school for any reason other than graduation, transfer, death, or release for early admission to a university. The study included 74 male and 69 female dropouts from nine New Mexico school districts. It was found that more males than females dropped out; the number of dropouts increased until grade 11; the age at which the greatest number of male dropouts occurred was 17, while more females dropped out at age 16; approximately 29% of the dropouts were released from school because of truancy; 35% were released but the reason for withdrawing was not reported; 14% withdrew because of transfer and/or family move; and the greatest number of males left school in October, while the greatest number of females left school in December. (LS)

Sherman, Julia. COGNITIVE PERFORMANCE AS A FUNCTION OF SEX AND HANDEDNESS: AN EVALUATION OF THE LEVY HYPOTHESIS. Psychology of Women Quarterly, V. 3, N. 4, pp. 389-90, Summer 1979.

Investigates incidence of left-handedness in high school students. Handedness did not affect math or verbal performance in 9th or 10th graders. For 11th graders, significant sex-by-handedness-by-measures interaction was found. Results do not support the hypothesis of Levy's of left-handedness decreases spatial performance and benefits verbal performance. (Author)

Sherman, Julia. MATHEMATICS, SPATIAL VISUALIZATION, AND RELATED FACTORS: CHANGES IN GIRLS AND BOYS, GRADES 8-11. Journal of Educational Psychology, V. 72, N. 4, pp. 476-82, August 1980.

Although girls and boys were similar in cognitive skills and attitudes toward mathematics in grade 8, boys performed significantly better in mathematics by grade 11, even with mathematics background controlled. No sex-related difference in spatial visualization developed. (Author/GDC)

Sherman, Julia. PREDICTING MATHEMATICS PERFORMANCE IN HIGH SCHOOL GIRLS AND BOYS. Journal of Educational Psychology, V. 71, N. 2, pp. 242-9, April 1979.

Females' and males' ninth grade scores for three cognitive tests and eight mathematics attitudes scales were used to predict mathematics performance. These scores significantly predicted mathematics performance 1-3 years later. Spatial visualization was an important variable, significantly predicting geometry grade for girls, but not for boys. (Author/RD)

Sherman, Julia. SUMMARY OF EFFECTS OF BIOLOGICAL FACTORS ON SEX-RELATED DIFFERENCES IN MATHEMATICS ACHIEVEMENT. Paper presented at the annual meeting of the American Educational Research Association (New York, NY, April 4-8, 1977).

Critically reviewed evidence relevant to hypotheses of biological sources of sex-related cognitive differences as they relate to mathematics achievement include the following: explanations based on the assumption of greater variability in male cognitive performance; sex-related differences in serum urate; effects of estrogens compared to androgens on cognitive functioning; recessive X-linked hypotheses of the inheritance of mathematical problem solving and spatial visualization, and hypotheses of sex-related differences in brain lateralization, including how they relate to rate of maturation. Empirical support of these hypotheses is weak and mostly inconsistent with available data. Some tentative support was found for the role of earlier left cerebral dominance in females as a factor, interacting with educational and cultural experiences, which could lead more females than males to emphasize a verbal, analytic rather than a spatial, gestalt approach. Research implications are discussed. An annotated bibliography is included. (Author)

Sherman, Julia. WOMEN AND MATHEMATICS: SUMMARY OF RESEARCH FROM 1977-79 NIE GRANT, FINAL REPORT. ED 182162.

Two samples of students who had been extensively tested in grades 8 and 9 were followed up three years later, one sample being used to partially replicate results from the other. Data obtained included mathematics courses taken in high school, mathematics grades, retesting for knowledge of mathematics concepts, mathematical problem solving, spatial visualization, and attitudes toward mathematics. Data were used to differentiate among girls and boys taking 1-4 years of the college preparatory mathematics sequence and to predict later mathematics and spatial performance. Results are consistent with the view that sex-role factors influencing attitudes toward mathematics are most important in creating sex-related differences in mathematics performance. (Author/MK)

Sherman, Julia, and Fennema, Elizabeth. THE STUDY OF MATHEMATICS BY HIGH SCHOOL GIRLS AND BOYS: RELATED VARIABLES. American Educational Research Journal, V. 14, N. 2, pp. 159-68, Spring 1977.

Male and female high school students enrolled in mathematics classes were compared concerning their intent to enroll in additional mathematics classes. Significantly more males than females, especially from the lower

half of the achievement distribution, intended to continue mathematics courses. Sex differences in attitudes towards mathematics are also reported. (Author /MV)

Taylor, Ross. EQUITY IN MATHEMATICS: A CASE STUDY. Paper presented at the National Council of Teachers of Mathematics Core Conference, Reston, Virginia, February 20-21, 1982.

During the middle and late '70s the Minneapolis Public Schools recognized a underrepresentation of women, blacks and American Indians in high school math courses. They have attempted to correct this by implementing various new programs. Among them are a "Math Bridge Program" for 8th grade students to bridge the gap to high school, a program which provides women role models to speak in schools, a campaign to show how math is used in many occupations, staff development training in equity, and efforts to eliminate racist and sexist math materials from the curriculum. Other studies and methods are cited in support of these attempts. After six years (1975 to 1981) results show higher percentages of blacks and women in high school math courses, though not as high a level of participation as expected. American Indians have remained at the bottom showing no significant change. (CDRJ)

Tomizuka, C. and Others. MATHEMATICAL ABILITY: IS SEX A FACTOR? Science, V. 212, N. 4491, pp. 114-21, April 1981.

Reader responses to an article by Benhow and Stanley in the December 1980 issue are presented. The letters are followed by a response by the authors of the original article, who clarify points and stress the magnitude of the sex difference uncovered in their research. (MP)

Wolleat, Patricia L. and Others. SEX DIFFERENCES IN HIGH SCHOOL STUDENTS' CAUSAL ATTRIBUTIONS OF PERFORMANCE IN MATHEMATICS. Journal for Research in Mathematics Education, V. 11, N. 5, pp. 356-66, November 1980.

This study's purposes were to test causal attribution theory in the masculine typed, content-specific task domain of mathematics and examine the effects of level of mathematics achievement, sex, and the interaction level of achievement and sex on attribution patterns. (MP)